Countering Weapons of Mass Destruction

Dr. Gregory F. Simonson
OASD(NCB/NM)

NDIA Disruptive Technologies Conference
November 8-9, 2011
Washington, DC

CWMD PSC Membership

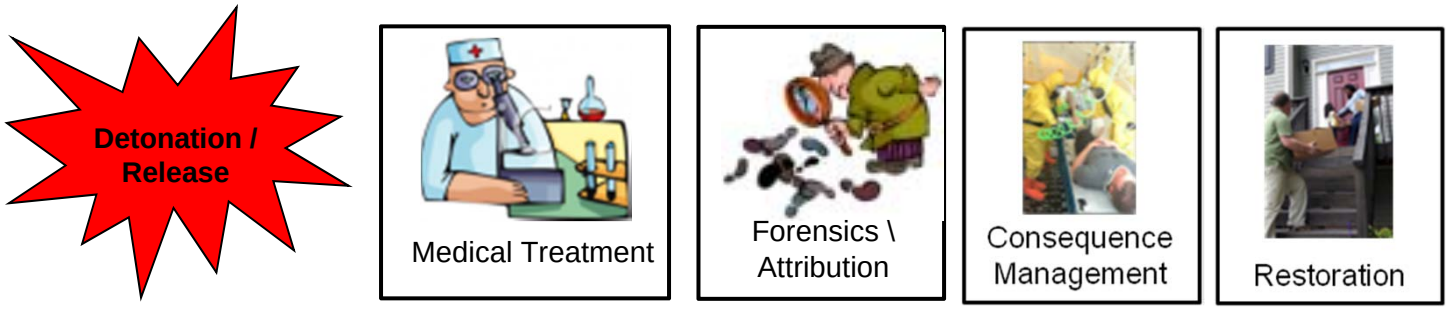
NCB/NM	Greg Simonson (Chair)
NCB/NM	Michaela Eddy
Joint Staff	Leonard Izzo
Army	Eric Zimmerman
Navy	William Thompson
Air Force	Mark Fagan
OUSD(P)	Jessica Cox
OUSD(I)	Michael Spence
DTRA	Tony Pang
DTRA	Stephanie Vaughn
JASONs	

"We must ensure that terrorists never acquire a nuclear weapon. This is the most immediate and extreme threat to global security."

President Obama, Prague, Czech Republic, April 5, 2009

Scope of CWMD Challenge Problem

Challenge Problem



Systems Performance Goals

- Broad Area Search
- Persistent Monitoring
- Tagging and Tracking

Technical Challenges

- Systems Integration
- Activity Recognition
- Advanced Signature Detection & Tracking
- Advanced Radiation Detection

CWMD Problem Statement

Scenario: Imminent theft of nuclear weapon from a foreign storage facility by terrorist cell with insider assistance

- **The U.S. needs improved capability to deal with a potential future "loose nuke" emergency involving a foreign nuclear weapon or significant amount of special nuclear material (SNM)**
  - **Earlier cue that a plot is afoot or a theft has occurred**
  - **Faster access to the area**
  - **Improved monitoring ability and TTL**
  - **Higher confidence in containment and search**
- **Radiation detectors alone will not solve the problem**
  - **Persistent range constraint; emplacement; shielding…**
- **ISR technologies, lower latency, networks of networks, and social media may be part of the solution**

What S&T investments are central to loose nuke problem and in what architecture would new technologies be deployed?

Loose Nukes Parameter Space

	Technical Challenge	Objectives	Technical Approach
3-5 years	Existing data fusion	CWMD community in complete concert	Global CWMD Analysis System; sensor fusion
5-7 years	Alternate signature exploitation	Locate, monitor and track WMD at strategic distances	HSI, IR, FTIR, GPS, radar, lidar, RFID, nanoparticles, etc.
7-10+ years	All-source Information Integration	Pre-event cues, real-time activity detection	Net-networks; beyond physics sensing

Parameter Space: Signatures

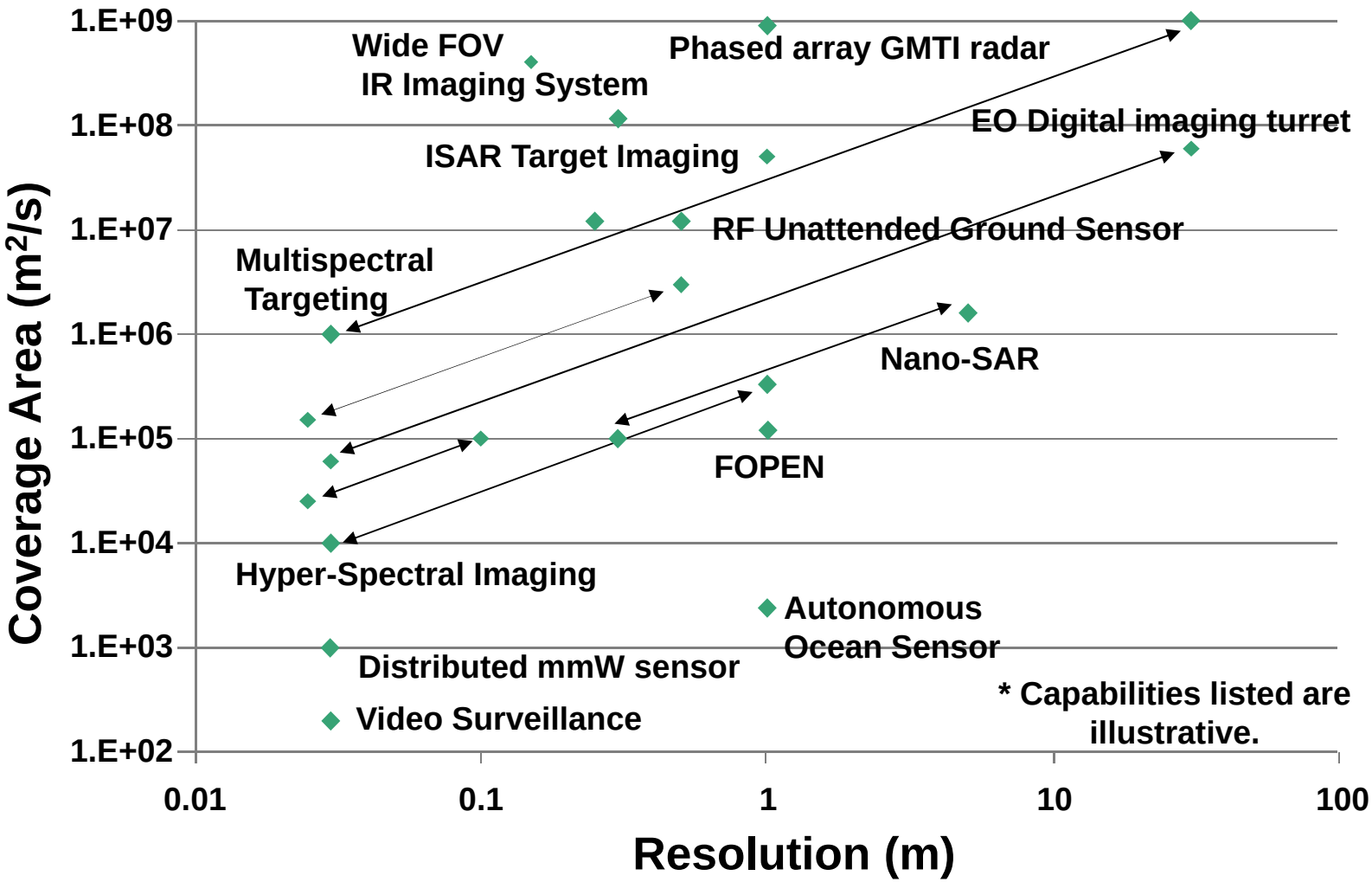
Target Class: Vehicle

Sub-Class: Passenger Car, Light Truck, Heavy Truck, APC, Tank

Observable	Signature	Sensor
color	absorbance	HSI
material	reflectance	HSI
heat	thermal gradient	IR
chem emission	hydrocarbons	FTIR/chem
size	pixels/return/reference scale	EO/radar
motion	doppler/angular change/GMTI/GPS*	Radar/lidar/FMV
weight	seismic/magnetic	geophone/accelerometer/ magnetometer
sound	acoustic/seismic	microphone/accelerometer
Location	Georeference/GPS	EO/SIGINT
EM	EM	EM (inductive/capacitive)
RF	RF	RFI/DF

And similar sets for payloads, people, facilities, sites…

Parameter Space: Sensors

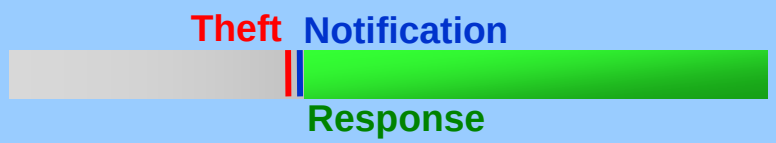
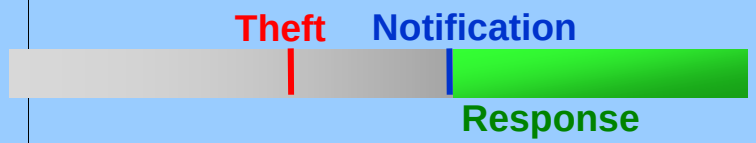
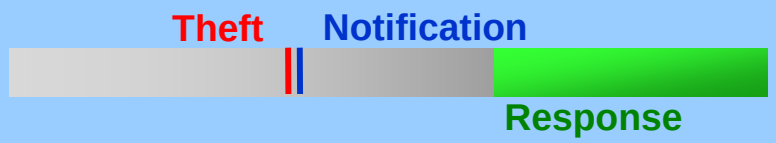
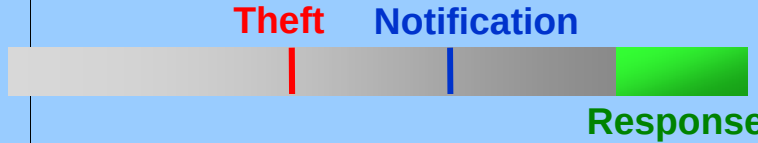


Source: The Technical Cooperation Program

Parameter Space: Architecture

(#) *Increasing Level of Difficulty*

Notification of "Theft"

Access to Region	Immediate	Delayed
Immediate	**1** • Search begins immediately • Search region small 	**2** • Search delayed by notification • Search region large 
Delayed	**3** • Search delayed by access • Search region large 	**4** • Search delayed by notification & access • Search region large 

- **Delays in response to theft (caused by late notification or access) increase the "level of difficulty" in recovering SNM**

Technical Challenges & Metrics

	Today	10 yrs
Confidence in getting a cue	**<10%**	**>>50%**
Sense change in SNM/NW state	Low	High
SNM rad detection (m)	<10	100
Alt signature readiness	Fair	Good
Sensor deployment latency	**days**	**<hour**
Sensor handoff	Poor	Perfect
Data/network fusion	**<10%?**	**100%**
Persistent surveillance (km^2)	100s	10,000s
Tracking confidence	Low	High
Broad area search (km^2/hr)	<10	1,000s
Behavior/intent detection	Low	High
Social network exploitation	**<10%**	**>>50%**
Architecture maturity	**Low**	**High**

Notional

CWMD "Loose Nukes" Roadmap

Needed Operational Capabilities

Pre-Positioned Assets, Intel Fusion, Cue, Containment, Locate, Recover

Technology Development Areas

Rad Detection **Persistent Monitoring/ISR** **TTL BAS** **Intent/Behavior** **Architecture**

Science and Technology Development

FY 15-17	FY 17-19	FY 19-22+
Systems Integration **Activity Recognition**	**Advanced Signature Detection** **Advanced Tracking**	**All-Source Information Integration** **Advanced Signature Detection and Tracking**
Integration of all-source intel and human reasoning, multi-sensor **data fusion**, pathway analysis, automated behavioral analysis	HSI, IR, FTIR, radar, lidar, RF, FMV, GPS, accelerometers, RFID, reduced data latency, **network fusion**	Integration algorithms, matrixed detectors, networks of networks, beyond physics: social network analysis, **automated all-source information fusion**

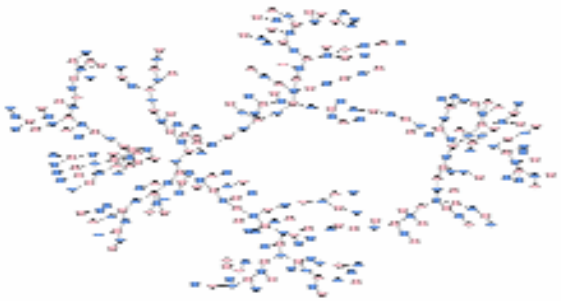
Revolving integration, demonstration and transition to meet operational needs

Note: These are not currently funded initiatives

Big Gaps: Opportunities for NDIA

- Next gen rad detection, e.g. nanomaterials; ionized air; HSI
- Alternate signatures related to weapon activity
  - People, programs, communications, facilities, behaviors…
- Persistent intelligence, surveillance and reconnaissance
  - Sensor development and platform integration
  - Technical, intelligence and social data fusion

- Data-to-Decision Tools
  - Next-generation reachback and information sciences capabilities
  - High performance computing
- Architectures for prompt access and low latency
- Beyond physics
  - Human behavior and intent detection
  - Social network analysis



BAAs and SBIRs

BAAs:

ARL Postdoc Fellowship Program	W911NF-11-R-0010
RDECOM-STTC	W91CRB-08-R-0073
ARO	W911NF-07-R-0003-04
ARL/ARO	W911NF-07-R-0001-05
DARPA	DARPA-11-34: I2O Office-Wide BAA
AFOSR	AFOSR-BAA-2009-1
AFOSR	AFOSR-BAA-2011-01
DHS	DHSS-TLRBAA11-03
DTRA	HDTRA1-11-16-RDIS-BAA
DTRA	HDTRA1-11-16-BRCWMD-BAA
ONR	BAA 12-001

also Special Notice 11-SN-0004 under this BAA, titled “Data to Decision”

SBIRs:

Army: https://www.armysbir.army.mil/default.aspx

DoD: http://dodsbir.net/solicitation/default.htm

CWMD Summary

- **Capability against loose nukes needs improvement**
  - **There is no silver bullet**
  - **Heavy reliance on early cue**
- **Radiation detection alone is not enough**
- **Many other signatures/sensors can be brought to bear**
  - **Substantial capability already exists**
  - **But data needs to be integrated**
- **Sensor handoff/sensor fusion/network fusion essential**
- **Opportunities in ISR for persistent surveillance, tracking, and broad area search in scenario-specific architectures**
- **Greatest gains may be in automating synthesis of sensor data, intel analysis, all networks including social networks, and non-physics based detection of behavior and intent**